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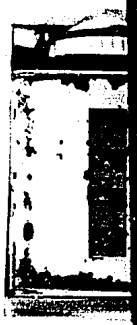

CONFERENCE OF SOVIET HYGIENE INSTITUTES ON THE PROBLEM OF IONIZING RADIATION

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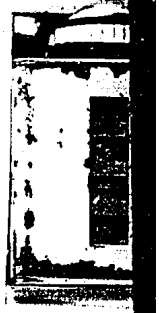
A conference of hygiene institutes on the problem of ionizing radiation was held in Moscow 26-30 July 1955. This conference was called by the Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR, and by the Academy of Medical Sciences USSR. This is the first conference on the subject held in the USSR. The importance of the subject and the novelty of many problems on which work is being done in this field imposed the necessity of conducting an extensive exchange of opinions. More than 300 persons from 37 cities of the Soviet Union participated in the conference. Among the participants were scientific workers from 25 hygiene and medical institutes, sanitary physicians, physicians of medical-sanitary detachments, personnel of sanitary-epidemiological stations, etc.

The basic tasks of institutes of hygiene in work on ionizing radiation were outlined in a report given by A. A. Letavet, Active Member Academy of Medical Sciences USSR (Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR). The author of the report dwelt on the state of the problem pertaining to hygienic standards of radiation under conditions when radioactive substances are resorbed by the organism. He also discussed future problems relative to the drawing up of hygienic standards in this field. Specifically, he indicated that the limiting dose of external gamma radiation amounting to 0.05 roentgen per day, which is accepted as a standard in the USSR, is 50-100 times higher than the natural background radiation. For that reason, one is faced with the task of further lowering the limiting dose on the basis of subsequent scientific work of an exhaustive nature.

Letavet pointed out the fundamental significance of the principle of fractional doses, which is being applied in the USSR, and of the rule of establishing a daily limit of exposure to radiation which is based on this principle. On the other hand, more consideration of total doses to which the subjects have been exposed during a certain length of time (for instance, of weekly doses), in accordance with the procedure adopted in the US and England, is not permissible. Letavet also pointed out that inadequate work has been done on setting standards as far as exposure to partial irradiation (for instance of the hands, head, etc.) is concerned.

In the report under discussion the problem of coefficients of the relative biological effectiveness of gamma rays and X-rays was discussed and the permissible daily exposure to them. Counting as 0.9 physical equivalents of a roentgen, was taken as a unit. On that basis, a coefficient of relative biological effectiveness for alpha radiation equal to 10 was proposed (i. e., the permissible dose for alpha radiation is accepted as 10 times smaller than that of gamma radiation). The coefficient of relative biological effectiveness for thermal neutrons then amounts to 5, for fast neutrons to 10, and for very fast neutrons to 20. The problem of the [exact] numerical values of these coefficients can be decided only by further research. Letavet also discussed problems pertaining to further work on the maximum permissible concentrations of radioactive substances in water and in air, pointing out that a great number of radioactive isotopes (more than 500) are already used at the present time.



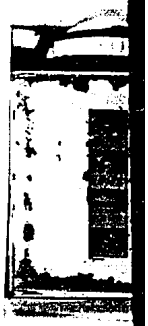
The author of the report states that during the [illegible] years work on the permissible concentrations of radioactive isotopes should cover the whole periodic table of elements as far as radioactive isotopes which are of importance from the standpoint of their effects on health are concerned. He called attention to the necessity of establishing standards in regard to the maximum levels of contamination with radioactive substances of working surfaces, walls, floors, clothing, hands, etc. Undoubtedly, the expansion of work on the setting of hygienic standards in the field of ionizing radiation will contribute to the more rapid development of acuity as far as controls applied by sanitary physicians are concerned.

Problems pertaining to further investigations in the field of hygiene in connection with work with radioactive substances and other sources of ionizing radiation were also touched upon and the subject of periodic observations of persons engaged in work in this field was discussed. Effective methods of individual protection and of investigations relative to the contamination of water reservoirs with radioactive substances were also touched upon. In connection with this, measures to be taken for the elimination of radioactive substances from water supplies were discussed. Finally, Letavet mentioned that the method of tracer atoms is still used to an inadequate extent in various investigations in the field of hygiene (e.g., investigations on problems pertaining to ventilation, sanitary chemistry, etc).

In a report by N. G. Gusev (Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR) the principles to be followed in the calculation of the limiting permissible concentrations of radioactive substance in water and in the air were considered. The technique of determining the maximum permissible concentrations of radioactive substances in water and in the air shows a number of significant differences which distinguish it from the ordinary methods of determining limiting concentrations of toxic substances that are current in everyday toxicology. As far as radioactive substances are concerned, calculation of the doses of radioactive substances which affect tissues, with consideration for the specific characteristics of the resorption of these substances by the organism, their distribution in the organism, their retention there, and their elimination, is of basic importance. In conducting work of this type, the physical and chemical properties of the radioactive substances (i.e., their half-life, their solubility in biological substrates, the energy of the ionizing particles emitted by them, their degree of dispersion, etc.) must be taken into consideration.

In conducting work dealing with the action of radioactive substances on the living body, the problem of determining the quantity of radioactive substances which has been retained in the organism is of importance in solving problems aimed at establishing the maximum permissible concentrations of substances emitting ionizing radiation to which a subject may be exposed. A report by Gusev on the determination of radium in the body dealt with this question. Under consideration of the processes of decay of radium and formation of such products of decay as radium B and radium C, which emit gamma radiation, Gusev proposed that the radium which is retained in the body be determined on the basis of the external gamma radiation (emitted by the body) and of the exhaled radon.

In the following three reports, problems which are of importance in connection with the prophylaxis of radiation sickness were discussed. Ye. Ye. Kovalev outlined the basic principles of calculating protection against gamma radiation. He demonstrated simplified methods of such calculations based on the use of tables and nomographs and presented nomographs with the use of which the protection rendered by different materials can be determined on the basis of the degree of attenuation of radiation. In a report by S. M. Cerodinskiy (Institute of Labor Hygiene and Occupational Diseases, Academy of Medical



Sciences USSR) the problem of individual protection in work with radioactive substances was discussed. In this report recommendations were given in regard to the application of individual measures of protection in various types of work with radioactive substances (work with quantities corresponding to use as indicators, work with shielded sources of radiation, work in which large quantitites of radioactive substances are used, and repair work).

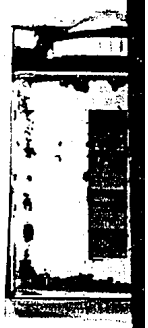
Of the greatest interest in the report was information on a new type of special clothing to be worn during work with radioactive substances, i.e., the so-called pneumatic clothing with a light, transparent "skafandr" [although "skafandr" literally means diving suit, it probably designates in this instance an outer layer of clothing provided with a helmet.] The principal part of this clothing is an overall made of plastic material. To prevent interference with the temperature regulation of the body, air is pumped into the pneumatic clothing. The most favorable conditions are maintained when 150-200 liters of air per minute are pumped into the suit. In a report by N. V. Vershinin (Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR), problems connected with the organization of dosimetric control in connection with work on radioactive isotopes were elucidated and the presently available dosimetric equipment was described.

Two reports by A. N. Marey (Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR) dealt with important problems of communal hygiene. In a report entitled "Elimination and Rendering Harmless of Radioactive Wastes in Work With Radioactive Isotopes" Marey discussed conditions which are dangerous from the sanitary standpoint and which may arise in connection with the contamination of the atmosphere and of bodies of water with various wastes containing radioactive substances.

The greatest danger from the sanitary standpoint is represented by release into the atmosphere of aerosols consisting of radioactive substances with a long half-life, with the result that the surrounding terrain may be contaminated. Undoubtedly one must pay great attention to the problem of effluents containing radioactive substances which may contaminate bodies of water. The author of the report discussed measures which would prevent the contamination of the atmosphere and of water with radioactive substances. He also touched upon presently available methods for the purification of effluents from radioactive substances. In this respect he called attention to the reliability of the method of evaporation (especially double distillation), the method of storing effluents which contain radioactive substances with a short half-life, and the successful results obtained by applying ion-exchange filters. He mentioned that the coagulation method deserves attention. When radioactive strontium is present in the water, use of trisodium phosphate as a coagulant yields good results. Marey stated at the conclusion of his report that the use of biological filtration methods gives encouraging results.

Of great importance are problems connected with the determination of the content of radioactive isotopes in the water of reservoirs and other bodies of water, particularly when only a small amount of contaminating substances is present. This problem was discussed in a second report by Marey entitled [Aquatic Organisms as Indicators of the Contamination of Bodies of Water With Radioactive Isotopes" (cf. Gigiyena i Sanitariya, No 8, 1955).

A number of reports dealt with problems of labor hygiene arising in work with radioactive isotopes and with sources of ionizing radiation. In a report given by N. K. Bakhusov (Leningrad Institute of Labor Hygiene and Occupational Diseases) problems of labor hygiene arising in metal radiography were subjected to discussion. The method of radiography with cobalt as a source of radiation was discussed. External irradiation with gamma rays is the most dangerous condition encountered in radiography.



The author of the report described a number of sanitary and hygienic measures which contribute to improvement of labor conditions in radiography (an effective arrangement of the storage room, measures aiming at the safe transportation of containers, etc). Noteworthy is the proposal that Co^{60} be replaced with other isotopes which emit a softer radiation, i.e., iridium, which has an energy of radiation amounting to 280-350 kev, selenium emitting radiation of 75-260-400 kev, cesium 177, lanthanum 140, terbium 161, hafnium 172, etc. It is regrettable that in suggesting improvements of labor conditions during radiography, the author of the report totally disregarded the possibility of using various types of protective water layers in storage rooms, which of course is a measure that will be very effective from the hygienic standpoint.

A report by N. U. Tarasenko and E. A. Bodrovaya (Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR) dealt with problems of labor hygiene arising in connection with work on radioactive luminescent compositions. Work with luminescent radioactive paint involves emission of radioactive aerosols and of the radioactive gases radon and thoron into the air of the rooms in which the work is conducted. These substances are products of the decay of radium, mesothorium, and radiothorium. Gamma radiation is of less significance in work with luminescent compositions. In the report under discussion, sanitary and hygienic measures were described which make it possible to improve radically the labor conditions in this type of work. Among these measures is improvement of the technological processes and of the equipment (introduction of a semi-automatic method of printing, use of effective shields and of properly designed work benches, application of efficient exhausts situated near the place where the work is conducted and of good general ventilation, and application of effective measures of protection against gamma radiation).

In a report by G. M. Parkhomenko and V. V. Nikitenko (Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR) problems of labor hygiene were discussed which have a bearing on work with radioactive isotopes in investigations of the wear of metal parts. To investigate the wear of metals, Co^{60}, Fe^{59} and Zn^{65} are used. In work of this type we encounter the danger of external gamma irradiation and of exposure to radioactive aerosols. Radioactive isotopes are used in determination of the amount of nonmetal inclusions in steel. Calcium 45 is used in work of this type. In connection with this field, radioactive aerosols constitute a considerable danger from the sanitary standpoint. Problems connected with the use of radioactive isotopes in metallurgy for marking steel and with the application of radioactive isotopes in medicine were also discussed in the report.

M. A. Kazakevich (Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR) presented a paper entitled "The Clinical Aspects of the Prolonged Action of Radioactive Luminescent Compositions on the Organism" and I. D. Makulova (Leningrad Institute of Labor Hygiene and Occupational Diseases) gave a report entitled "Data Obtained in the Course of Dynamic Observations Carried Out on Persons Occupied in Metal Radiography." While in Makulova's report data were presented which characterize the clinical aspects of chronic radiation sickness produced solely by external gamma irradiation, Kazakevich in his report discussed the clinical aspects of chronic radiation sickness produced by the combined action of radioactive substances resorbed into the organism (products of the decay of radium and mesothorium) and of external gamma radiation.

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[illegible] distinguishes [illegible] clinical [illegible]
radiation sickness. The first syndrome, [illegible]
least severe and most easily reversible. [illegible] by a moder-
ately pronounced cerebroasthenia accompanied by a heightened lability of
the vegetative nervous system and extensive functional disturbances in the
regulation of hemopoiesis. The second type of clinical syndrome in chronic
radiation sickness has a more strongly pronounced pathology which develops
along the line of an asthenovegetative [illegible] accompanied by phenomena of
[illegible] dysfunction. [illegible]
type of chronic radiation sickness [illegible] changes to which the nervous
system has been subjected [illegible]
[illegible] takes place [illegible] of the process
[illegible] encephalopathic [illegible]

Chronic radiation sickness is distinguished by the stereotype nature
of complaints of an asthenic character which invariably occur [illegible] changes on the
part of the nervous system [illegible] (particularly [illegible]
largement of the thyroid gland and disturbances in the functioning of genital
glands) effects on the eye (initial stages of a cataract), on the metabolism
(carbohydrate, water-salt, protein, and mineral metabolism) on the blood
(lowering of the number of erythrocytes, a level of hemoglobin in the medium
range and sometimes increased range, and increased color index, a lowering of
the number of leukocytes, a lowering of the number of thrombocytes), etc. In
the initial stage of radiation sickness lability and instability of the proc-
esses of hemopoiesis is noted. This applies first of all to leukopoiesis.

A number of reports were devoted to important problems of radiotoxicology.

In a paper by [illegible] B. Kurlyandskaya (Institute of Labor Hygiene and Occu-
pational Diseases, Academy of Medical Sciences USSR) data were presented which
characterize the phenomena of resorption, distribution, retention, and elimi-
nation of such isotopes as strontium 89, cesium 13[illegible], and ruthenium 1[illegible] under
conditions of continuous and prolonged experiments. Kurlyandskaya cited
interesting data on the resorption, distribution, and retention of ruthenium
106 which throw a different light on this problem as compared with conclusions
drawn from results obtained abroad. Thus, ruthenium 106 under conditions of
prolonged experiments is resorbed from the gastrointestinal tract to the extent
of 5.[illegible]% of the quantity introduced perorally. This exceeds by a factor of
100 the amounts reported by Hamilton and others. As distinguished from foreign
work, according to which ruthenium 106 accumulates principally in the kidneys,
Kurlyandskaya's results indicate that close to 32% of the ruthenium 106 is
found in the liver and 13-15% of the ruthenium 106 found in the organism is de-
posited in the bones, in which it remains for a long time. These data change
our ideas on the toxicology of ruthenium 106. In Kurlyandskaya's report inter-
esting results are also presented which indicate how a definite limit of the
deposition of radioisotopes in the tissues of the organism is established. This
limit depends on the quantity of the radioactive isotope which has been intro-
duced into the organism.

A report by A. A. Rubanovskaya (Institute of Labor Hygiene and Occupational
Diseases, Academy of Medical Sciences USSR) dealt with the accumulation of
radioactive isotopes in the body of embryos when female animals were exposed to
the prolonged action of radioactive strontium and cesium. Rubanovskaya's data
are of interest from the standpoint of remote consequences of the action of
radioactive substances.

N. L. Beloborodova (Institute of Labor Hygiene and Occupational Diseases,
Academy of Medical Sciences USSR) gave a report entitled "Data on the Prolonged
Action of Radioactive Ruthenium, Cesium, and Strontium Under Experimental Con-
ditions." On the basis of experiments continued for a long time (2[illegible]-3[illegible] months),

Beloborodova characterized the changes in the blood and general conditions of the animals as well as pathomorphological changes which are observed under such conditions.

Using extensive data obtained in her investigations, Beloborodova described three stages in the changes which peripheral blood undergoes in chronic radiation sickness. The initial period comprising the first 10-12 months of the experiment is characterized by an instability and lability of the hemopoietic system of animals expressed by considerable fluctuations in the number of reticulocytes, leukocytes, and thrombocytes. The second stage, corresponding to a period of 12-20 months from the beginning of the experiment, is characterized by relative normalization and stabilization of the indexes of peripheral blood. However, the quantity of reticulocytes remains at an increased level during this period. In the third stage there is a more or less pronounced suppression of hemopoiesis, particularly if radioactive strontium has been used. The duration of the phases and the degree to which they are expressed vary with the radioactive isotopes to which the animals have been exposed. Among the isotopes used in the experiments strontium proved to be the most toxic.

Of definite interest is the use by the author of the report of some functional tests (pregnancy, bloodletting) which tax to a certain extent the body of the experimental animals and particularly their organs of blood formation. These tests disclose the instability, the incomplete normalization, and the inadequate extent of stabilization of the indexes of the peripheral blood.

A report by D. S. Kushneva (Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR) dealt with the characteristics of the radiotoxic of radon. Experiments were carried out with three groups of white rats. The animals of the first group were exposed to radon which they resorbed by inhalation in a concentration of 8×10^{-5} curies per liter. The second group inhaled this gas in a concentration of 4×10^{-5} curies per liter and the third group in a concentration of 2×10^{-5} curies per liter. Exposing the animals four times to these concentrations of radon during one hour led to their death. The inhalation of radon was found to produce acute changes in the organism of the rats. They developed chronic inflammation processes in the lungs accompanied by phenomena of fibrosis, affliction of the bronchi, and metaplastic processes leading to the formation of tissue of a tumor type. As a result of the inhalation of radon, the animals exhibited pronounced vascular changes culminating in hemorrhages. One must note that cessation of the inhalation of radon does not stop further progress of the pathological processes.

The method of tracer atoms offers great possibilities of carrying out investigations in the field of industrial toxicology and hygiene. A number of reports dealt with this subject. E. B. Kurlyandskaya (Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR) outlined her experience acquired in the application of the method of radioactive isotopes in industrial toxicology. She cited data on the investigation of the distribution of silicon in the organism upon intratracheal introduction obtained in experiments with the use of radioactive silicon. The greatest relative activity due to the resorption of radioactive silicon was found in the lungs, liver, kidneys, and lymph glands. Investigation of the distribution and elimination of hydrogen sulphide containing as a tracer S^{35} showed that the greatest quantity of active sulfur accumulates in the kidneys, liver, and suprarenals. The smallest quantity of S^{35} was found in the brain.

In the report by Kurlyandskaya, data were presented on the metabolism of liver phospholipids after poisoning with trinitrotoluolene, dichlorethane, and carbon tetrachloride. These data were obtained with the use of the radioactive isotope P^{32}. Data were also presented on the use of methionine containing S^{35}

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in studies dealing with disturbances of protein metabolism in chronic lead poisoning. Of definite interest is the use of the isotope Na^{24} in investigations on the permeability of blood vessels during silicosis. The permeability of the blood vessels of the eye was investigated by measuring the penetration of sodium 24 from the blood into the liquid of the anterior ocular chamber of rabbits.

In an interesting report dealing with the investigation of metabolism in occupational poisonings by the method of radioactive isotopes, A. A. Yudeles, G. A. Prokopenko, V. A. Mikhaylova, I. Ye. Okonishnikova, T. I. Kazantseva, and R. V. Bessarobova (Sverdlovsk Institute of Labor Hygiene and Occupational Diseases) presented extensive data on the investigation of the metabolism of phosphorus compounds during poisoning with fluorine, vanadium, and manganese compounds. In the investigation of the toxicology of aluminum with the use of radioactive phosphorus, one could detect disturbances in the distribution of phosphoric acid between its free form and its combined with organic substances. The toxic action of aluminum compounds is characterized by the splitting off of inorganic phosphorus from its organic compounds.

In this report [illegible] that manganese chloride interferes with the distribution of vitamin B_1 containing S^{35} between internal organs and also between divisions of the central nervous system. The report also presented some data on disturbances of protein metabolism as a result of the action of silicic acid on the body. These data were obtained by using labeled methionine and radioactive phosphorus as a tracer.

In a report by M. A. Khvoynitskaya (Kiev Institute of Labor Hygiene and Occupational Diseases) data were presented on the determination of the volume of intracellular liquid in the bodies of animals and of the volume of blood with the aid of the radioactive isotopes of sulfur and phosphorus. V. A. Kislenko and G. G. Lysina (Kiev Institute of Labor Hygiene and Occupational Diseases) reported on results of an investigation carried out by introducing carbon disulfide containing radioactive sulfur. In another report by Khvoynitskaya data were cited on modifications in the distribution of water in the organism as a result of the action of high temperatures. Radioactive isotopes were also used in this investigation.

Although a multiplicity of problems was discussed at the conference and the results presented were of definite scientific importance and novelty, one must regretfully note that a great number of institutes of hygiene have not as yet participated in work on the important range of problems pertaining to ionizing radiation. Primary importance is not yet being attached to these problems at a number of USSR institutes of hygiene. The conference of representatives of institutes of hygiene and of chairs of medical institutes passed a resolution which the principal lines along which work on ionizing radiation should proceed in the future have been indicated.

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